HANDBOOK

FOR

Process Photographers

A Practical Guide to the Making of Line and Half-Tone Negatives by the Wet Collodion Method For Use in the Photo-Engraving Process

BY

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INTRODUCTION.

The purpose of this book has been to provide a practical guide for the beginner or apprentice, who desires to make himself better acquainted with the details concerning the production of line or half-tone negatives by the wet-collodion process.

The importance of the study of the scientific laws upon which the practical work is founded cannot be too strongly urged, as it is the possession of this knowledge which makes the difference between an intelligent operator and a "hit and miss" workman. The principles underlying the art are not so mysterious or vague, but what anyone with a little study and practice can arrive at a clear conception of their meaning. The explanation relating to screen distances, stop openings, etc., has been dealt with in its logical order. The results sought after will not come haphazard, but must be gotten by careful workmanship, based on definite scientific principles.

Whatever have been the errors of omission or commission, the writer has conscien-sciously tried to present the various details of the work in such a manner that it will be of benefit to the largest number of students and beginners.

LINE NEGATIVE MAKING
BY THE
WET COLLODION PROCESS

THE COPY TO BE REPRODUCED

The first consideration in the making of a line negative for the Photo-Engraving Process is the copy to be reproduced. It should be preferably a drawing or sketch in good black ink on perfectly smooth white paper or card. This is placed on the copy-board so as to lie absolutely flat. A piece of clear glass placed over the copy will accomplish this and will also prevent any creases from showing. If the copy lies in rolls or is not parallel with the ground glass and sensitive plate, there will be a distortion in the resulting image.

FOCUSING THE IMAGE

Our next step is to focus the image on the ground glass sharply, reducing or enlarging it according to requirements. This is done by placing the ground glass focusing frame in position, opening the lens up wide to admit as much light as possible, and then with the aid of a focusing cloth to exclude all the light except that which passes through the lens, making the necessary adjustments. The operation will be found simple enough if we remember that the nearer the lens or camera as a whole is to a copy board, the larger will be the image, and the farther away, the smaller it will be. Sharpness is obtained by moving the ground glass back and forth until it is in the same plane at which the rays of light reflected from the copy come to a focus in back of the lens.

MEANING OF "FOCAL LENGTH"

This is definite, as every lens has a certain focal length; that is, the rays of light when an object 100 feet or more is focused on, or in other words, when they are coming parallel, come to a point or focus at a certain distance from the nodal point or optical center of the lens. The distance will be found with most lenses to be about equal to the diagonal of the plate for which it was intended to cover. In the case of an 8x10 plate, thirteen inches is about right. This, however, does not mean that smaller plates cannot be used with it.

CENTERING THE IMAGE

Great care must be taken to see that the image is centered on the ground glass, or else it may not be in the right portion on the sensitive plate. Moving the copy board to the right or left or up and down, or moving the lens, changes the position of the copy on the ground glass.

AVOIDING REFLECTIONS

The last precaution to be taken before making a plate ready preparatory to exposure, is to see that there are no reflections from the copy, as this is quite likely, if the original has been covered with a piece of glass. Stand beside the camera and place the head in front of the lens, looking directly at the copy. If there are any reflections from windows, etc., they will quickly be noticed and can be screened out.

We are now ready to prepare a plate for exposure in the camera.

REMOVING OLD FILM

Pieces of glass of the desired size (for practice work 5x7 will be found plenty large enough) are placed in a crock of lye solution:

Crude Caustic Soda.....2 lbs.
Water ..... 1 gal.

This will loosen the old film which may have adhered to the glass from previous use. Sometimes straw is placed in the receptacle along with the glass to separate it thus preventing it from sticking together. In any case, the glass should be placed in the solution one at a time, so that both sides will be affected by the lye. After being allowed to stand for twenty-four hours, the glass is taken out and scrubbed thoroughly on both sides with a stiff bristle brush.

FURTHER CLEANSING IN ACID

It is then placed in another crock of dilute nitric acid:

Nitric acid .....1 qt.
Water ..... 1 gal.

This further removes any organic matter and renders them chemically clean. After standing another twenty-four hours, they are taken out and washed under the tap to remove all traces of the acid, and then while still wet, flowed with the following solution:

White of one egg (= about 1 oz.)
Ammonia (acts as preservative)
..... 15 drops.
Water ..... 32 oz.

ALBUMENIZING

The egg must be well dissolved and the solution filtered. After flowing over once with the solution and draining (this removes the excess of water), it is flowed again, drained and placed in a rack to dry. The excess solution from the second flow may be drained back into the pouring glass and used again. A piece of cheese-cloth tied around the lip of the graduate will prevent bubbles from getting on the plate. For convenience sake, it is best to place the albumenized side

always one way, as when the plates are dry it is very hard to detect which side has been coated, although sometimes it is possible to tell by rubbing the finger nail over both surfaces—the smoothest is generally the coated side. If the plates were not coated with this substratum, it would be impossible to make such a substance as collodion adhere and not be rinsed off during the operations of washing.

SENSITIZING THE PLATE

(Collodion.)

We are now ready to sensitize a plate for exposure in the camera. It is first flowed with a solution of collodion. This in the plain form is a mixture of pyroxyline or gun-cotton dissolved in equal parts of sulphuric ether and grain alcohol. This alone, if kept well stoppered, will keep indefinitely. To it are added, however, such halogen salts as will be found necessary. These salts of chlorine, bromine and iodine, when dissolved in ether and alcohol, especially for this purpose, are called the "iodizer". Many of the engraving firms at the present time prefer to buy a collodion base with the iodizer separate, and mix together as needed. This has the advantage that a large amount need not be made up at a time, and thus any waste from spoiling with age is avoided. For those who prefer to mix their own, the following formula will be found equally suitable for either line or half-tone work:

Ether	16 oz.
Alcohol	16 oz.
Cadmium Iodide	75 grs.
Ammonium Iodide	45 grs.
Calcium Chloride	15 grs.
Strontium Chloride	15 grs.
Gun-cotton	175 grs.

The iodides and chlorides are dissolved in part of the ether and alcohol and then added to the remainder. The cotton is then added

and allowed to thoroughly dissolve. The iodizer, as the prepared solution is called, will also keep indefinitely, but when added to the ether and alcohol, the whole solution after three or four weeks, gradually turns to a deep red, at which stage it will be found practically useless. This red color is caused from the iodine being liberated, and this iodine in such quantity acts as a great restrainer, thereby making the plate less sensitive to light. The most desirable color is of a rich straw yellow. New or "green" collodion will be found to work very fast and have a tendency to give fuzzy or veiled images, while old or too "ripe" a collodion will work just the opposite. The effects which the various iodides and chlorides have in the collodion are as follows: Cadmium iodide gives softness, ammonium iodide gives contrast, strontium chloride gives density and acts as a preservative, while calcium chloride absorbs the excess of moisture in the solvents. An excess of ether closes the pores in the film so that the silver salts do not penetrate as well, while an excess of alcohol makes the film porous and rotten. This is the reason why old collodion gives a rotten, crumbly film, as the ether evaporates more in proportion to the alcohol. In warm weather, because of rapid evaporation, and in flowing large plates, it is better to use more ether and alcohol for a given amount of solution. Always keep water out of the collodion, as water in the solution will precipitate the gun-cotton. If using a freshly iodized collodion for line work, be careful not to over-expose. The best results can be gotten with a collodion that has been iodized for some time and is well "ripened".

COATING WITH COLLODION

Before coating a plate it should be carefully dusted with a camel's hair brush, kept especially for the purpose. Always brush

both sides and in one direction. A brisk back and forth movement will simply attract more dirt and dust to the plate.

Hold the plate with the albumen side up in the left hand with the first two fingers underneath and along the edges, and the thumb on top on the corner. The collodion, which, of course, has been carefully filtered, as any dust or dirt in the film leaves a mark, is flowed in a pool on the upper part of the plate, the right top corner being covered during the pouring and the plate gently tilted so that the left corner is next covered, then the left bottom corner, and finally the excess of collodion drained off at the right bottom corner, as shown in the illustration below. During these operations, the bulk of the collodion should be kept on the center of the plate, which is only tilted enough for the collodion to flow to the edges, but not over it and off the plate. At all times care should be taken to see that the collodion is kept flowing forward and that no "flow-back"

Wrong Way

Right Way

occurs, otherwise the collodion will thicken and cause a mark in the negative. The draining of the excess collodion should be done gradually, the plate being tilted slightly at first, and then gradually brought to a vertical position. During the whole time of draining the plate must be rocked back and forth to prevent ribbed marks from running

towards the draining corner. After the collodion has started to set, it is a good plan to scrape off the right and bottom or heavy edges, as they contain ether and alcohol, which is ruinous to a silver bath. When the film has set sufficiently, which is ascertained by touching the lower right hand corner and noting if the greasiness has disappeared, the plate is ready to be immersed in the silver sensitizing solution in the dark-room.

SILVER BATH

The silver bath or sensitizing solution is made by dissolving silver nitrate in distilled water until it tests between 40 and 45 degrees by the hydrometer or argentometer. If ordinary tap water is used, the bath must be set in the sun until the organic matter present has settled to the bottom as a black precipitate and then filtered. Nitric acid is now added drop by drop until blue litmus paper turns red in a few seconds, or between 12 and 18 drops for every 24 ounces of solution. Before use, the bath must be iodized. A plate coated with collodion left in for several hours will be sufficient, or if the bath is to be used at once, a few crystals of iodine will answer the same purpose. If the bath does not contain a certain amount of iodine to act as a restrainer, the action of the silver nitrate in combining with the iodides in the collodion will be so great as to cause minute pin-holes over the entire surface of the plate.

The collodionized plate is now placed in the silver bath and allowed to stand for three or four minutes. If a tray is used instead of a glass dipping bath, it must be rocked occasionally during the time of immersion. In lowering the plate into the bath, care must be taken to do it with an even, steady motion, for if this is not done, a streak will be the result. The plate must not be removed too soon, as it will not be sufficiently light

sensitive and will be streaked, whereas, if left too long, it will look blue and thin on being taken out, and will give a weak image. A bath testing much less than 40 degrees necessitates leaving the plate in for an abnormal length of time, and if over 45 degrees, the plate will look streaked on being taken out and will have a veil or deposit over the entire surface. The chemical action involved when a collodionized plate is placed in the silver bath is known as double decomposition. The ammonium iodides, for example, combine with the silver nitrate to form silver iodides (a light sensitive substance) and the ammonium nitrate is thrown off as a by-product.

After the plate has been allowed to remain in the bath for the desired length of time, it is raised carefully out of the container, drained, and the back wiped dry with a tuft of cotton. In holding the plate during this operation, it is necessary to keep it in such a position that any dirt from the hands will drain along the lower edges and not across the surface.

On holding the plate to the dark-room light, it will be seen to have a rich lemon yellow, not blue or not too much of an orange. Too blue and thin generally means too much acid in the bath, while if too orange, then there is not enough. It is now placed in the plate holder with the emulsion side away from the operator. Strips of blotting paper about a half inch wide should be laid along the silver clips at the bottom to prevent any dirt from them being drawn onto the surface of the plate by capillary attraction, and also to prevent the excess silver solution from dripping on other parts of the holder and rotting the wood, as the silver is very corrosive. Now close the door of the holder, fasten and be sure the slide is firmly in place. In carrying the holder to and from the dark room and camera, it should always be held in an

upright position and not tilted around or laid down flat, as the silver solution is apt to run back across the surface of the plate and cause markings. Now after bringing the holder out from the dark room, place it in the position that the ground glass occupied, remove the slide, and cover all with the focusing cloth to prevent any possibility of light leaking in and fogging the plate. The ark lamps placed one on each side of the camera should be adjusted to illuminate the copy as evenly as possible, and reflectors used to concentrate the light and also to prevent it from shining directly into the lens.

EXPOSING

Before removing the cap from the lens, the diaphragm should be turned down to about F32, or in the case of stops, one in size to correspond with that reading for that particular lens should be placed in the slot provided for that purpose. Often the question is asked, "Why do we use such a small portion of the light that might be allowed to pass through the lens? Surely, the more light, the less exposure." Simply this: All lenses, due to an inherent law of optics, are subject to various abberations, such as, spherical, chromatic, etc., and it is at their outer margins that they are the least corrected. Therefore, by using only the center or more fully corrected portions, we are able to secure sharper images and without distortion. Now in exposing, remember this: the greater the enlargement of the original copy, the more exposure necessary, and vice versa, or also, the greater the bellows extension (distance from nodal point or optical center of lens to ground glass) the more the exposure, as this distance varies accordingly. The reason for this variation in exposure is plain. A certain volume of light governed by the size of the stop passes through the lens. Now if we spread it over a large area,

Amount of Reduction or Enlargement	PROPORTINAL EXPOSURE TABLE *The following table gives the correct time for all different reductions and enlargements when the same stop is used.*					
1/8	:32	·63	·95	1·26	1·582	3·164
1/7	33	,65	·98	1 3	1 6	3·26
1/6	·34	·68	1·	1·36	1·7	3·4
1/5	·36	·72	1·1	1·44	1·8	3·6
1/4	4·	·8	1·2	1·6	2·0	3 9
1/3	45	9	1·3	1·78	2·22	4·44
1/2	56	1·1	1·7	1·9	2·8	5·625
3/4	76	1·53	2·3	3·06	3·8	7·656
7/8	88	1·76	2·7	3·5	4·4	8·82
Same Size	1	2	3	4	5	10
1 1/8	1·13	2·26	3·4	4·5	5·6	11·29
1 1/4	1·27	2·53	3·8	5·06	6·3	12·66
1 1/2	1·56	3·12	4·7	6·3	7·8	15·625
2	2·25	4·5	6·75	9	11·25	22·5
3	4	8	12·	16	20	40
4	6·25	12·5	18·75	25	31·25	62·5
5	9	18	27	36	45	90
6	12·2	25·5	36·8	49	61·25	122·5
7	16	32	48	64	80	160
8	20·25	40·5	60·75	81	101·25	202·5

as in the case of an enlargement, there will be a resulting thinner layer than if we concentrate it over a small space. On the opposite page will be seen a table with relative exposure values for different amounts of enlargement or reduction. Aside from the size of stops and amount of enlargement or reduction, the strength of the lights and character of the copy have to do with exposure. The light reflected from a bluish white copy will affect the plate more than that reflected from a yellowish white copy, as wet collodion plates are affected most by the blue and blue-violet or actinic rays of light.

DEVELOPING

After the plate has been exposed for a sufficient length of time, the lens is capped, slide placed in position in the holder and plate holder removed to dark room. Upon removing plate from holder, no change will be noticeable—the image is in what is known as a latent state. The light has brought about a certain change in the silver iodides in the emulsion, but exactly what is a matter of speculation. However, it is supposed to be this: for every molecule of silver iodide wherever the light has acted, one atom of iodide has been liberated. These resulting sub-salts, as they are called when the iodine has been liberated, have one important property, namely: an affinity for reduced silver nitrate. Now to bring the image into a visible state, it is only necessary to treat the plate with some substance which will reduce the surface or free silver to the metallic form thereby allowing it to attach itself to the aforementioned sub-salts in relative position to correspond with wherever the light has acted. Actually this is exactly what is done. This solution or developer, as it is called, is made up of:

Iron Sulphate (to test 25 degrees by hydrometer) .....64 oz.

Acetic Acid No. 8 (28 per cent Commercial) .....8 oz.

In flowing the solution over the plate care must be taken to cover the entire surface evenly and at as near the same time as possible. If this is not done, certain portions will be acted upon longer than others, and a streak will result. The plate should be held in the left hand much in the same manner as when flowing with collodion, and the developer flowed along the right and heavy edge. The developer should not be flowed on with a rush as wherever it strikes the plate very hard, the silver is washed away from that portion, and a thin spot will result. Proof of this theory in regard to the contention that density is built up from the silver on the surface of the plate as it is reduced by the developer, is found in the fact that, should the plate be washed thoroughly after exposure and before development, no image of any density can be gotten by any amount of development. Therefore it is necessary in flowing on the developer to have just enough to cover the plate, as any of the solution allowed to spill over the edges will carry silver with it and thus prevent the image from becoming as dense as it might have otherwise. The acetic acid acts as a restrainer in that the silver, as fast as it is reduced, is made to discriminate between the various portions of the plate which have been acted upon most by light and those which have not. If no restrainer is used in the developer, a veil or fog will be seen to cover the plate, and the image will flash up as soon as the solution is poured over the surface. The correct time for development is between 20 and 30 seconds. A longer time signifies under exposure, while a shorter time means that the plate has been over-timed. In development, the portions of the plate corresponding to the white parts of the copy will be seen to get denser and denser, until a

certain point is reached at which there is a pause. This is the signal to stop the action of the developer and the plate is immediately placed under the tap and washed thoroughly. And to wash well at this particular point is imperative, otherwise in the subsequent operations a blue stain will appear. Over-development causes a fine deposit of silver to appear, in which should otherwise be the transparent parts of the negative, and under-development produces a thin image.

FIXING

At this stage of the process we have a film of unacted upon silver iodide and the negative image in metallic silver. This unacted upon silver iodide must be removed from the plate so as to render it permanent and not susceptible to the further action of light. A solution strong enough to dissolve silver iodide and still not strong enough to dissolve metallic silver is what is desired. This is found in Potassium Cyanide and the result of the action of this substance is called "fixing". Hypo-sulphite of soda may be used, but the cyanide works quicker and cleaner, and is more easily washed out of the film. The usual method of working is to mix a solution consisting of:

Potassium or Sodium Cyanide (sat. sol.) ..... 1 oz.
Water ..... 5 oz.

and flow over the plate until the silver iodide is thoroughly dissolved out of the film, which should take about twice as long as it takes the plate to clear. If there is a slight veil or scum over the surface of the plate which can be removed by rubbing with the ball of the finger, it is a sign of insufficient acid in the silver bath.

INTENSIFYING

The negative image is now in metallic silver alone, but before it can be used prac-

tically, it must be intensified, so as to obtain an image in clear transparent lines corresponding to the black portions of the copy against a perfectly opaque background, thus preventing any light from passing through during the operation of printing on sensitized metal. After thorough washing, we place the plate in a solution of:

Potassium Bromide (sat. sol.)..1 oz.
Copper Sulphate (sat. sol.).....8 oz.

The Potassium Bromide and Copper Sulphate combine to form Copper Bromide, which combines with the metallic silver in the image to form silver bromide plus copper bromide. On placing the plate in the Copper Bromide solution, it will be seen to turn black and then slowly bleach out white. When the film has bleached clear through which is ascertained by looking at the glass side, the action has been carried far enough. In regard to washing the plate after taking it out of the Copper and before blackening in the silver intensifying solution—just enough water to wash the excess Copper and Bromide from the surface, for if too thorough a washing is given at this point, all of the Copper and Bromide will be washed out of the film and the plate will refuse to blacken in the silver. In fact, at no time should a strong stream of water be allowed to play on any one particular spot in the plate—it is much better to keep the plate moving while washing. Sometimes the plate when placed in the Copper will refuse to bleach out or at any rate very slowly. This is caused from an insufficient quantity of Potassium Bromide. However, too much Bromide will cause the plate to bleach TOO quickly and then it will not blacken well. Now then, after bleaching and washing, we are ready to intensify it in the silver intensifying bath. This is made up in exactly the same way as was the silver sensitizing solution, except that it should test about 25

degrees instead of 40 degrees. The longer the plate is left in this solution, the denser it will become up to a certain point. Of course, the plate should at least be left in long enough to blacken through to the glass, which in all cases can be determined by looking at the glass side. In order to obtain perfect density in the background, it is necessary to perform this operation of bleaching in the Copper Bromide and intensifying in the silver at least twice. If two times through is found insufficient, then continue the operation until the desired results are obtained. If, however, after three or four times through, the image is still not dense enough, one will know that the negative was too thin to start with. Experience, however, will teach one to know whether the preceding operations have been correct by the way the image comes up in the developer, so that further work on the plate can be avoided. Under-exposure is the most general cause of thin negatives, although, of course, there are many other reasons. A freshly made silver intensifying solution will sometimes give streaks, but the addition of a few drops of Nitric Acid will insure its working smoothly. The solution should be of the strength given, as the use of a weak bath is apt to give trouble in "cutting". The plate may reduce suddenly and unevenly.

"CUTTING" OR REDUCING THE IMAGE

Now, after removing the plate from the silver for the final time, wash thoroughly and examine the transparent parts with a magnifying glass by holding the plate before the light. If they are seen to be absolutely clear, nothing further need be done, except to "blacken", which will be explained later, but if there is seen to be a fine grain or deposit of silver, it must be removed or "cut out", as it is called. This is done by applying a solution which will slowly dissolve the entire image. Naturally the thinnest portions

are affected first, and when the parts corresponding to the black portions of the copy are seen to be perfectly clear, the action of the "cutting" solution is stopped. We take advantage of the fact that silver iodide, of which the plate was originally composed, is soluble in cyanide. So we pour a solution of:

Potassium Iodide .....3 drams.
Iodine (resublimed) .....1 dram.
Water ..... 6 oz.

over the film until it has bleached to a yellow, turning it to iodide of silver. This also intensifies the image greatly. The Potassium Iodide is necessary in order to dissolve the Iodine in the solution and also to aid in bleaching the negative. If too little Potassium Iodide is used, the bleaching action is slow, and if too much is used the negative bleaches out quickly and very little intensification is gotten. After rendering the image soluble by applying the iodine, we proceed to flow over the plate a weak solution of Potassium Cyanide—about ½ dram to 8 or 10 ounces of water. This slowly begins to dissolve away the image, and when the action has been carried far enough, as will be seen when the lines appear clear and transparent, the plate is washed thoroughly under the tap.

BLACKENING

To complete the negative, it is only necessary to blacken it. We do this by flowing over the plate a solution of:

Sodium Sulphide (sat. sol.).....1 oz.
Water .....6 to 10 oz.

until it has blackened clear through. This changes the silver iodide of which the image was composed to silver sulphide—the blackest and most permanent state into which silver can be changed. If a slight yellow stain should appear, it can sometimes be removed by flowing the plate over with:

Nitric Acid .....1 oz.
Water ..... 20 oz.

or, better still, an application of the Nitric Acid solution BEFORE blackening will generally prevent the yellowness from appearing.

OTHER METHODS OF INTENSIFICATION

There are other methods of intensifying the image besides Copper and Silver, but this is the most universally used, as it is simpler to work and permits of greater manipulation. However, for those who may be interested, we list the following:

"LEAD"

Where great intensification is desired, make up a solution of:

Lead Nitrate .....3 oz.
Potassium Ferricyanide .....3 oz.
Glacial Acetic Acid (98 per cent) 3 oz.
Water to make up to.....64 oz.

The plate is placed in this until bleached clear through to an even yellow, then washed thoroughly, flowed with the Nitric Acid solution (1 to 20), washed again and blackened with Sodium Sulphide, after which it is again flowed with the Nitric Acid to prevent any possibility of staining. Any necessary reduction of the negative must be done immediately after fixing by flowing with Iodine and Cyanide, as it cannot be done afterwards. This intensifier works very energetically and is used mostly for coarse line work. One drawback to its use is found in the fact that Lead intensified negatives are sometimes hard to strip.

"MERCURY"

Sometimes for fine line work and where maximum density is not necessary, the Mercury intensifier is used.

Mercuric Chloride .....5 oz.
Ammonium Chloride .....3 oz.
Water to make up to.....64 oz.

Bleach in this solution, wash, and blacken with Sodium Sulphide as usual. Any reducing in this case should also be done before intensification.

DEFECTS IN NEGATIVES

The best plan when a trouble arises that you are not sure as to exactly what it is would be to eliminate one by one each of the three general sources from which all troubles arise aside from the camera, lens, etc. First look to the developer, then to the collodion and finally to the silver bath. Although the logic of this order may seem reversed to some, still on trial, it will be readily seen that it is easier to test developer and collodion first and silver bath last than to work the other way to.

THIN NEGATIVES

Under exposure.
Under development.
Weak silver bath.
Insufficiently iodized silver bath.
Excess of acid in silver bath.
Plate not left in bath long enough.
Bath too cold.
Collodion too old or too thin.
Intensifying chemicals not right.

UNEVEN DENSITY

Uneven flowing of collodion.
Uneven flowing of developer.
Uneven lighting of copy.
Uneven "cutting" with cyanide.

STREAKS

Silver bath too strong.
Not rocking plate when flowing collodion, or collodion being too thick.

Scum on surface of bath.
Plate being stopped when lowering in silver bath.
Removing plate from bath too soon.
Alcohol in bath causing developer to flow uneven.

TRANSPARENT SPOTS

Dust in collodion or silver bath.
Overiodized silver bath.
Undissolved salts in collodion.

BLURRED OR DOUBLE IMAGES

Improper focusing.
Dirty lens.
Movement of lens, plate, or copy-board during exposure.

FOG

Light struck.
Insufficient acid in silver bath.
Bath too warm.
Insufficient acid in developer.
Developer too strong or too warm.
New or unripened collodion.
Over-exposure or over-development.
Fumes of chemicals, such as Sulphide, etc.

OYSTERS

Dirty plate, plate holder, blotters, wiping cotton, etc.
Prolonged exposures, especially in hot weather.

YELLOW STAINS

Collodion not dried enough or too thick.
Not washed enough between chemical operations.
Old or too strong a sulphide solution.

THE HALF-TONE PROCESS.

(Everton Method.)

The fore part of this book dealt with the practical working methods of producing negatives to be used for the Line Photo-Engraving process; that is, the reproduction of copies in which there were only two tones—black and white. We shall next consider the methods and means by which photographs, wash drawings or any other copies which have gradations between black and white, can be reproduced by what is known as the half-tone process.

To begin with, it is necessary for us to remember that the image in a photo-engraved plate is in relief and in the same plane, and that all parts are covered with a layer of ink OF THE SAME THICKNESS when a roller is passed over the plate. Therefore, to obtain the effect of tones other than black and white, it is necessary for us, not to vary the thickness of the ink (which is a physical impossibility in the typo-graphic printing process) but to have small areas in perfect proximity to one another and varying in size.

THEORY

This is accomplished by breaking up the continuous tones in the original photograph into dots of different sizes by placing in front of the sensitive plate during exposure a screen or grating, the small transparent holes in which act as lenses to the light passing through. That is, each bundle or rays as it strikes the opening will be concentrated and brought to a point of focus on the sensitive plate. The theory underlying this screen action is based on the law of optics, which says

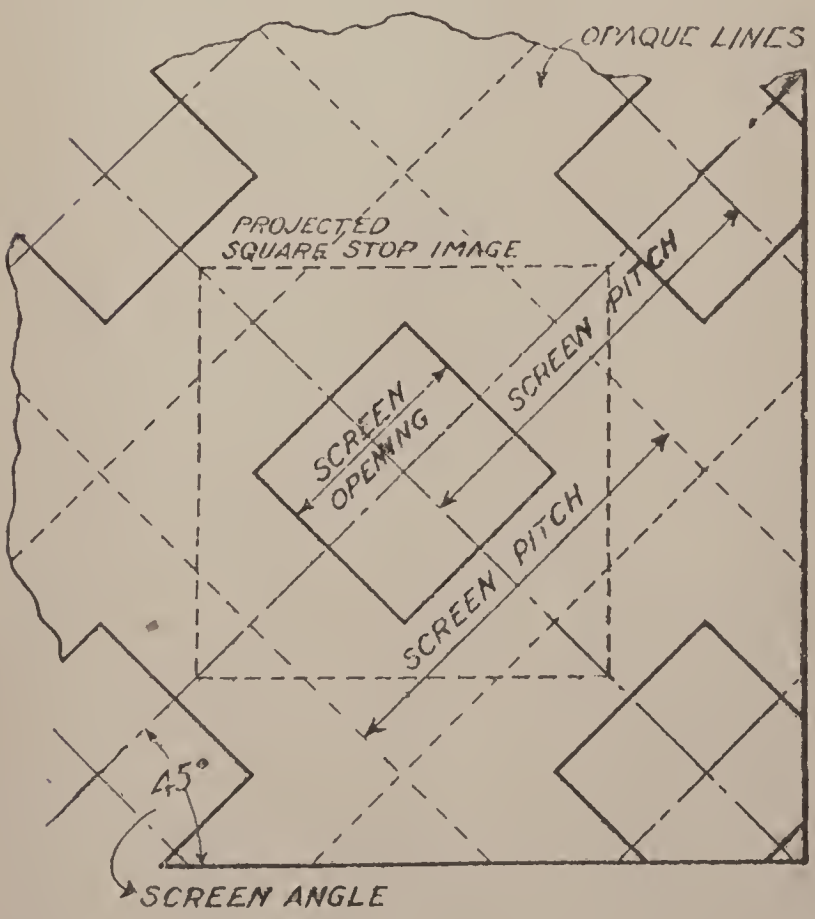
that light after passing through any opening, whether round, angular, or square, will conform itself into a round pencil of rays with the greatest intensity at the center, if given sufficient space. One can compare light on passing through some small opening under the conditions just mentioned to sand passing through the small opening in an hour-glass. The sand as it piles up forms a pyramid or cone, and the longer the sand trickles through the opening, the larger the pyramid grows. This is exactly what happens when light passes through one of the small openings in a half-tone screen. It forms a dot with the greatest density at the center and the ultimate size of which depends on the amount of light which has acted upon it.

THE HALF-TONE SCREEN

Just a word now, before continuing, as to the nature of the half-tone screen which we use. It is made as follows: Two pieces of optically plane glass are covered with an acid result. They are then placed in a specially constructed machine, invented by Max Levy, at Philadelphia, Pa., and ruled in parallel lines any number to the inch with a fine point which scratches through the resist coating, leaving the glass clear. It is then flowed with hydrofluoric acid until the glass has etched slightly. All traces of the acid resist film are cleaned off and the indentations made by the acid are filled with a black pigment. The two pieces of glass with their lines crossing each other at an angle of 90 degrees are cemented together with Canada balsam, and the edges bound together with aluminum to protect them from injury. One of these pieces of glass is always made of the same thickness (3|32 in.) to facilitate accurate measurement of the distance between sensitive plate and screen ruling or screen separation as it is known. This thin or cover

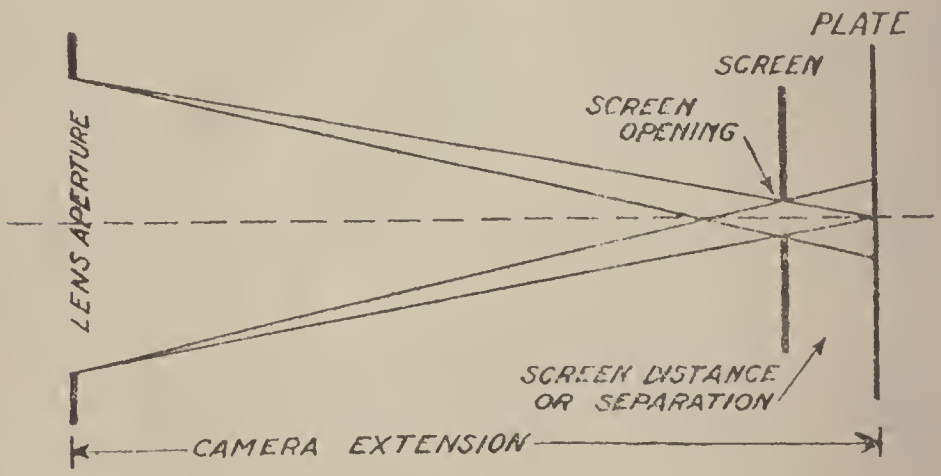
glass side of the screen is distinguished by the manufacturer's name, patent, date, etc., being engraved in the aluminum edging.

In the sketch below, the terms, such as screen opening, screen ratio, etc., become readily apparent. The opaque lines in the screen are ruled at an angle of 45 degrees with the sides of the plate. This is because the dots or screen effect in the final reproduction is less noticeable, as will be readily seen by just looking at a newspaper halftone right side up and then without moving it nearer or closer, twisting it a quarter turn.



FINDING SEPARATION AND STOPS TO USE

The drawing is to represent the rays of light passing through the lens, through an opening in the screen and finally striking the plate. As mentioned before, it is necessary, in order that the light after passing through one of



the openings in the screen can be concentrated to a point on the sensitive plate, to have the distance between the opening and the sensitive plate correct, and this depends on the size of the opening in the screen. As will be seen from the illustration, hand in hand with this goes the size of the opening in the lens, as this alters the angle at which the light strikes the screen and plate. Varying the stop or opening in the lens or the distance between screen and sensitive plate would give us like results. In order for us to fulfill the theoretical considerations heretofore mentioned, it is necessary to estimate the variable parts of the equation accurately. It can be expressed in the following rule: Separation is to Screen Opening as Extension is to Stop. The practical working out of this problem in ratio is seen at the bottom of the table opposite. Another rule which works out the same as the one above is what is

NORMAL SCREEN SEPARATION

Basis on 64 to 1 ratio; that is separation = 64 x screen opening

50	=	20/32	= 5/8
60	=	17/32	= 9/16
70	=	15/32	= 1/2
80	=	13/32	7/16
85	=	12/32	
90	=	11/32	= 3/8
95	=	11/32	
100	=	10/32	= 5/16
110	=	9/32	
120	=	9/32	= 1/4
133	=	8/32	
150	=	7/32	
200	=	5/32	
250	=	4/32	= 1/8
300	=	3/32	
400	=	2/32	= 1/16

EXAMPLE

Sep : S.O :: Ex : Stop

17/32 1/120 24"

$$\frac{1}{120} \cdot \frac{24}{1} = \frac{1}{5} \div \frac{17}{32} = \frac{3}{8}$$

known as the 64 to 1 ratio; that is, Separation is 64 times Screen Opening, and the Stop is 1|64 of the extension. The table gives the correct distance that the screen ruling should be placed away from the sensitive plate in 32nds of an inch for all ordinary ruled screens.

MAKING A TRIAL EXPOSURE

Suppose now, after putting the desired screen in place in the plate-holder or camera and getting the correct separation by measuring, we focus a copy and prepare to make an exposure. Everything is handled the same as in line work until we come to exposing. Here we find it necessary to use a certain stop, the size of which is found according to the foregoing rules. The exposure is governed by the character of the copy. Upon examining the negative after developing and fixing, we find that we have our image in dots of various sizes. In the parts corresponding to the light portions of the copy, the dots will be larger and in the dark portions, smaller because for a given length of time more light is reflected from a white part of the copy than a dark.

However, if we look in certain parts of the negatives wherein the copy, it was perfectly black and no light reflected, we will notice that there is no dot formation at all, and in the parts corresponding to the white portions of the copy, the dots are just touching at the corners.

WHY A "FLASH" AND "HIGHLIGHT" IS GIVEN

Now. in negatives used for Photo-Engraving, it is necessary that we have a solid dot, though very small, even in the deepest shadows, and in the highlights, the dots should be of such a size that they overlap, so that in between a group of four there will only be a small transparent opening. Therefore,

In addition to our main or detail exposure, we generally give two short auxiliary exposures, known as a "flash" and a "highlight". The "flash" exposure is made by using a small stop about one-half the size of the straight and exposing to a white sheet of paper for a period of time depending on the density of the shadows in the copy—for normal work approximately one-tenth of the detail exposure. The "highlight" exposure is made through a stop about two-thirds larger than the straight for a length of time about equal to the flash and. of course, to the copy itself.

For the "highlight" different shaped stops may be used, the object being to make it easier for the dots to connect at the corners, this being possible because of the fact that the shape of the dots take the form of the stop used if sufficient exposure is given. The dotted lines in the drawing of the half-tone

screen show the projected image of a square stop, and from this it can readily be seen why the dots will connect at the corners easier if a square, or a square with corners extended is used for the highlight rather than a round.

RESULTS OF AN EARED STOP

However, where we gain in ease of manipulation, we lose in the quality of our results. When an eared stop is used for the highlight, the dots in the three quarter whites and middle tones have a tendency to connect

even for the shortest exposure and this, of course, means a loss of gradation in the light portions of the copy, as it will give broad areas of white without detail. This fact may be taken advantage of where great contrast is wanted, as then an eared or square stop is sometimes desirable.

ROUND STOPS ARE BEST

However, most operators of the present day will agree that when the best possible results are to be achieved in the use of ANY screen and a truthful reproduction of the copy gotten, round stops should be used for all exposures. To the beginner this may seem a trifle hard, as it is more difficult to obtain good connections in the highlights when a round stop is used, so for that reason I advocate the use of a square stop to start with, but to work with round stops exclusively should be the aim of all conscientious workers.

METHODS OF WORKING

Now, as to the methods of working. After we have put a new copy on the board and focused to the desired size, we have brought about a change—namely, the extension. And this will call for a difference somewhere if we are to adhere by our rules of proportion. In order to fulfill those requirements, we must either change the separation or the size of stops. Most workers prefer to vary the lens aperature instead of the screen separation with every change of bellows extension, because there is more leeway in working considering the fact that to obtain good results, especially with a fine line screen, the separation must be correct almost to the one-hundredth part of an inch. Then the only difference in handling various copies aside from the all important part of exposing is the size of the stops to use.

Table of normal size stops for use with different bellows extension on the basis of "flash" being 1/2 the diameter of detail or "straight" and the length of one side of square or eared highlight stop being 2/3 larger than "detail."

Extension	Flash ○	Detail ○	Highlight □
8	1/16	1/8	7/32
12	3/32	3/16	5/16
16	1/8	1/4	13/32
20	5/32	5/16	17/32
24	3/16	3/8	5/8
28	7/32	7/16	21/32
32	1/4	1/2	27/32
36	9/32	9/16	1"
40	5/16	5/8	11/32
44	11/32	11/16	1 5/32
48	3/8	3/4	1 1/4

If round stops are used for highlight, let the diameter be equal to the diagonal of proposed square stop.

To find the equivalent area of a square given diameter of circle: Multiply the diameter of circle by 0.866 which will give length of one side of square.

Therefore, for the same copy, no matter what the enlargement or reduction, we would always give the same exposures providing we used stops in accordance with out calculations. For handy reference to be used as a basis from which to work, I have provided a table which gives the sizes of stops to use for different bellows extensions.

NECESSITY OF CONVERTING F NUMBERS INTO INCHES

As the size of stops to use for the different exposures is computed in inches, it is necessary for us to convert the F numbers on the lens if the lens is provided with an "iris" diaphragm into inches. The table following gives the nearest equivalent readable fractions of an inch of the lens openings, for the different focal lengths of lenses used. To find the size in inches of F 8, for example, on a lens with a different focal length, simply divide the focal length by 8 and so on for the other F numbers.

FINDING FOCAL LENGTH OF LENS

If the focal length of the lens in use is not known, then focus a copy same size, measure the distance from ground glass to copy board and divide by four, which will give the correct focal length.

In some cases of a great enlargement, it might so happen that according to calculations, our highlight stop would be larger than the lens would allow, so we simply move the ruled screen farther away and then figure the size of stops according to the given rule.

EXPOSING FOR DIFFERENT KINDS OF COPIES

As to exposing for different kinds of copies. In the first place we must remember that our object is to start with as small dots as possible, consistent with hardness, in

F numbers and their equivalents for focal lengths of :-

FOCAL LENGTH OF BASES	9	11	12	13	14	15
F 8	1 1/8	1 3/8	1 1/2	1 5/8	1 3/4	1 7/8
F 11	3/4	1	1	1 1/32	1 1/4	1 1/4
F 16	5/8	5/8	3/4	3/4	7/8	1
F 22	3/8	1/2	1/2	5/8	5/8	3/4
F 32	1/4	5/16	3/8	3/8	7/16	1/2
F 45	3/16	1/4	1/4	1/4	5/16	5/16
F 64	1/8	3/16	3/16	3/16	1/4	1/4
FOCAL LENGTH OF BASES	16	17	18	19	20	24
F 8	2	2 1/8	2 1/4	2 3/8	2 1/2	3
F 11	1 1/2	1 1/2	1 1/2	1 3/4	2	2
F 16	1	1	1 1/8	1 3/16	1 1/4	1 1/2
F 22	3/4	3/4	3/4	1	1	1
F 32	1/2	1/2	1/2	5/8	5/8	3/4
F 45	3/8	3/8	3/8	3/8	1/2	1/2
64	1/4	1/4	5/16	1/4	5/16	3/8

the shadow portions, and from that grow gradually in size until they touch at the corners and finally overlap. If the dots were all of the same size, we would have no image, as it is only in their variations that we obtain detail. That must be kept in mind when giving the different exposures. A certain size stop will on exposure allow the dots to grow to a certain size and stop. Of course, there will still be a little spreading action of the light beyond this, but not enough to affect the results materially. Now, suppose we are giving the straight exposure. If the dots in the lightest portions have grown as large as they will and we continue exposing, the dots representing the tones lower down will continue to grow, and if this is carried too far, we will have what is known as a high-key negative; that is, one in which the general tone of the picture is too light and a faithful reproduction of the original will not be gotten. On the other hand, if too short a straight exposure is given, we will have a low-key negative, and the general tone of the picture will be too dark. In other words, we desire to get as much variation in the sizes of the dots as possible—this means detail and gradation. The "flash" exposure should only be sufficient to give a small hard dot in the deepest shadows. The "highlight" exposure will vary with the character of the high lights in the different copies. Aside from this, some etchers desire the transparent openings larger or smaller than others. The operator should learn to make them any desired size and then individual tastes can be catered to. All copies, I think, can be divided practically into five different classes. We will take them up separately and attempt to suggest methods of exposing for each.

1. Flat and Sepia copies: That is, one in which the shadows are gray or brown, not black, and the highlights are gray or yel-

low, not white. A short "flash" should be given, as during the "straight" exposure the small starting dots will grow larger in size as even the deepest shadows reflect light in a copy like this. A normal "straight" should be given. Naturally, it will take a longer "highlight" than usual, as there is not as much light reflected from a gray or yellow portion as from a white.

2. "Contrasty", one in which the shadows are very black and the highlights white. A longer "flash" than usual, a normal straight, and a short "highlight".

3. A copy in which the middle tones of the picture are too dark and the object is to lighten them slightly. In this case a normal flash, longer "straight" and normal highlight should be given.

4. Then, for one that is too light, a normal flash, short straight, and a highlight long enough to give the desired connections should be given.

5. For GROUPED copies, pick out the deepest shadows and the highest points of light. Expose for these accordingly, giving a normal "straight".

Of course, there are exceptions to all rules, and the operator must use his own judgment, but from the foregoing suggestions. the exposures for other copies will present themselves. Sometimes it is not necessary to give as many as three exposures as in the case of a copy with very gray shadows, when no "flash" will be needed, or in the case of a copy in which the middle tones are dark and the "highlights" very white, then no "highlight" is given, as the dots will connect up sufficiently during the long "detail" exposure. Also, it is not always possible or desirable to keep the stops in the proportions listed, as, for example, in the case of a copy with very gray or yellow highlights, when an extra large highlight stop will have to be used. It is generally better

in exposing for a copy with gray highlights to give a short exposure through a larger stop than the other way round, as sometimes when the dark portions reflect light, weak connections are apt to be built up between the shadow dots. Matte surface copies require less "flash" and more "highlight", while glossy copies necessitate more "flash" and less "highlight".

GETTING CONTRAST OR FLATNESS AS DESIRED

To produce contrast, one should give a normal "flash", short "straight" and a long "highlight". For detail, give a normal "flash", long "straight", and a short highlight". The shadows in all negatives with any screen should be as small as possible, though very hard and dense. The highlight openings on coarse screen negatives to be printed and etched on zinc should be very small, but in the negatives for "copper", the finer the screen, the more "open" the highlights should be so as to allow for etching down, thus obtaining depth and good printing qualities.

MANIPULATION AT THE SINK

In manipulating the negatives at the sink, one will soon learn to know just how many times to "copper" and "silver" before flowing with the iodine solution and "cutting". The highlights will continue to intensify together after the shadows have stopped growing in size or at least more so in proportion. This, and the fact that a strong "cutting" solution has a tendency to "cut" shadows more in proportion to "highlights" and vice versa, may be taken advantage of in the case of a faulty exposure. Also after "cutting" the "highlights" may be greatly intensified by an application of copper and silver.

After all is said and done, experience is the best teacher providing it is logically in-

dulged in under the surveilance of one who can offer helpful suggestions and give sound advice. So, when it comes to a chance for learning grasp every opportunity, as today it is the man who knows and knows he knows and isn't afraid to make good use of his knowledge that is in demand.

RESULTS OF WRONG SCREEN SEPARATION AND SIZE OF STOPS

If, on examining the negatives after "fixing", we find that the shadow dots are square and the high lights "open", providing the correct stops have been used and an adequate exposure given, it is a good sign that the screen is too close. On the other hand, if the shadow dots are very fuzzy and the highlights closed and fuzzy, then the separation is too great. If the highlights or the shadows are affected separately, then we know that it is either the size of stops we are using or the exposure.

SCREEN RULINGS AND WHAT USED FOR

60—Rotary newspaper presses, where work is to be sterotyped.

85—Flat-bed presses, used for small newspapers.

120—Medium grade book and pamphlet work.

133—Magazine and catalogue work.

150—Best grade of catalogue work.

200—Used only on the best grade of paper.

300-400—Used very rarely and then only on double coated paper for microscopic reproductions, etc.

Proportional Increase and Decrease of Exposure Time

	1/2	1/3	1/4	1/5	1/6	1/7	1/8
.15	22	20	19	18	17	17	17
.30	45	40	37	36	35	34	33
.45	1:07	1:00	56	54	52	51	50
1:00	1:30	1:20	1:15	1:12	1:10	1:08	1:07
1:15	1:52	1:40	1:33	1:30	1:27	1:25	1:24
1:30	2:15	2:00	1:52	1:48	1:45	1:43	1:41
1:45	2:37	2:20	2:15	2:06	2:02	2:00	1:58
2:00	3:00	2:40	2:30	2:25	2:20	2:17	2:15
2:15	3:22	3:00	2:49	2:42	2:37	2:34	2:32
2:30	3:45	3:20	3:07	3:00	2:55	2:51	2:49
2:45	4:07	3:40	3:26	3:18	3:12	3:08	3:06
3:00	4:30	4:00	3:45	3:36	3:30	3:26	3:22
3:15	4:52	4:20	4:03	3:54	3:47	3:43	3:39
3:30	5:15	4:40	4:22	4:12	4:05	4:00	3:56
3:45	5:37	4:57	4:41	4:30	4:22	4:17	4:13
4:00	6:00	5:20	5:00	4:48	4:40	4:34	4:30

RECTIFYING AN OLD SILVER-BATH

After long use, the silver bath will become over-iodized, giving pin holes and also charged with ether and alcohol, this causing the developer to flow greasy and uneven. When in this condition, the bath is practically useless and should be given a complete rectification. Proceed as follows: First, neutralize with ammonia or bi-corbonate of soda. When neutral, the solution will neither turn blue litmus paper red, or red blue. A bath when acid will hold more organic matter in solution than when neutral or alkali—hence the reason for neutralizing it.

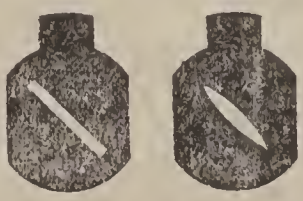
Now pour the bath into approximately an equal amount of COLD water—never pour cold water into the bath. The sudden chilling throws the iodides out of solution, so that on subsequent filtering, the greater part of them are removed. Now boil the bath down until it is a pasty mass. At this point brown fumes of iodine will be seen to rise in the form of vapor. After cooling, add water to the desired amount of bath and test for strength. After adding silver nitrate to bring it to 45 degrees, set in the sun until clear. When ready for use, filter into bath container and acidify. The important point to remember in conjunction with the silver bath is to keep it from being contaminated with foreign substances. Always keep all utensils separate that are to be used in the handling of the silver solution, and nine-tenths of the troubles frequently encountered will vanish.

MISCELLANEOUS.

HIGHLIGHT NEGATIVES are those in which the highlight portions are entirely closed or solid; that is, there are no transparent openings in between the dots. This effect can be gotten in most copies by just giving the usual exposures and then supplementing these by a short auxiliary exposure, through regular high light stop, about one-half the length of time with the screen moved away from the plate as far as it will go. By sufficient intensification the highlight portions will close up altogether and be a solid mass.

If this method will not give the desired results, then take the negative with the highlights closed as much as possible, and from this make a contact positive. The highlights in the positive will then be represented by very fine pin point dots, which can easily be cut entirely away with the cyanide solution. Now, a negative made from this positive will have the highlights represented by solid masses just as is desired.

BEN DAY EFFECTS over the white portions in line copies, such as dots of any size, parallel lines, or sausage shaped lines can be obtained direct in the negative. Set the



screen at the correct distance, insert one of the stops suggested in the illustration and expose to a white sheet of paper for a sufficient length of time to obtain good

density. Now move the screen as far away as it will go or remove it altogether and make a normal exposure to the line copy itself through the stop ordinarily used for this work. On development, the image will be solid and the rest represented by dots or parallel lines or bologna shaped lines, as the case may be.

A tooled effect in the highlights when making a negative of an ordinary photograph can be gotten by using the slit or elliptical stop for the highlight exposure in place of the usual round or square.

As to the sizes for the slit or elliptical stops, the width at the center should be equal to the diameter of correct straight stop and the length equal to the diagonal or diameter of proportional highlight stop.

Many other effects can be gotten by making two negatives of an original copy—one in which the "flash" and "detail" have been given, and the other with only the "highlight" made through some special shaped stop —and then stripping one on top of the other.

POSITIVES of either line or half-tone negatives can be made in two ways. If a same size positive is wanted, it may be made by contact in the plate holder. Place the negative and sensitized plate emulsion to emulsion, with pieces of blotting paper at the corners to separate them from actual contact, on the clips in plate holder, and expose to a white sheet of paper for the same length of time and with the same stop as would be used in making an ordinary line negative. If the positive is to be made larger or smaller than the original, then the negative must be placed in a "kit" in front of the lens and focused accordingly. The other operations used from exposing are the same as in the usual line work.

MEZZOGRAPH SCREEN NEGATIVES

The Wheeler Mezzograph screen, although not used very extensively, can still be made good use of by those who are willing to see some of its points of superiority—namely, those in which a result is desired other than the mechanical effect of geometrically spaced dots produced by the half-tone screen. It is made by flowing an acid resist medium, solvent in alcohol, over an optically plain piece of glass. The alcohol evaporates, and as the Pyrobetulin dries, it reticulates, and the cracks thus formed are of an irregular nature. The plate is now etched slightly with hydrofluoric acid. The resist medium is removed and the screen is complete. Varying the thickness of the acid resist and changing the amount of solvent used, will produce screens having varying degrees of texture, which may be compared with the regular half-tone screens in their uses. The methods of working is similar to the ruled screen, except that it must be placed much closer and a single stop and exposure will generally be found sufficient. F45 will be about right, and the exposure will depend on the amount of enlargement or reduction and the character of the copy. If on examining the negative after fixation, it is seen to consist principally of small round dots with fuzzed edges, then the screen is too far away, or if the negative seems to be sharp, but made up of little irregular blotches with curly tails protruding from them, then the screen is too close. Generally once or twice through copper and silver will be enough to produce a good printing negative, as hardly ever is the iodine and cutting solution necessary.

SPLICED NEGATIVES

Spliced negatives are those in which different parts of the image are on separate plates. The main points to remember for this

work are not to change the size of the copy for the separate exposures and to have enough of the image on each plate to allow for overlapping in the "stripping". The other manipulation for either line or half-tone, are carried on in the usual manner for the separate processes.

THREE AND FOUR COLOR WORK

This is an advanced branch of half-tone operating, but any good black and white operator will have little trouble in mastering its details, if he will but give it the necessary thought and study. The magnitude of this subject is so great that it hardly comes within the scope of this small book. The working details may be found in the booklets put out by the different dry-plate manufacturers.

AVOIRDUPOIS WEIGHT —

437 1/2 Grains = 1 Ounce
16 Ounces = 1 Pound

APOTHECARIES WEIGHT

20 Grains = 1 Scruple
3 Scruples or 60 Grains = 1 Dram
8 Drams or 480 Grains = 1 Ounce
12 Ounces = 1 Pound

The 1/2 Scruple weight = 10 Grains
" Scruple " = 20 "
" 2 " " = 40 "
" Dram " = 60 "
" 2 " " = 120 "
" 3 " " = 180 "

FLUID MEASURE

60 Minims = 1 Fluid Drachm
8 Drams = 1 Ounce
16 Ounces = 1 Pint
8 Pints = 1 Gallon

PRINTERS MEASURE

72 Points = 1 Inch
12 Points = 1 Pica Em
6 Pica Ems = 1 Inch
13 Pica Ems = 1 Column

CHEMICALS USED IN OPERATING, AND THEIR SYNONYMS

The terms, V. S. P. and B. P., refer respectively to the United States Pharmacopeia and British Pharmacopeia. The grade C. P. is usually the purest obtainable. The grade, "Technical", is the ordinary commercial product, and may be crude, pure or "C. P."

SODIUM HYDROXIDE (Caustic soda, Sodium hydrate) N.aO.H.

Color and properties: White, deliquescent pieces, lumps or sticks. Keep well stoppered, absorbs water from the air.

Containers: Iron drums.

Fire hazard: Dangerous.

Railroad shipping regulations: Yellow label.

POTASSIUM CARBONATE (Potash, Pearlash, Salts of Tartar).

Color and Properties: White deliquescent, granular powder; alkaline reaction.

NITRIC ACID (Aqua fortis, Hydrogen nitrate) $H.N.O._3$

Color and properties: Transparent, colorless or yellowish, fuming, suffocating, caustic and corrosive liquid.

Grades: Technical (usually 36 degrees to 44 degrees Re.) Grade generally known as Aqua fortis, being about 41½ degrees Re., or 65.67 per cent $H.N.O._3$; V. S. P.; B. P.; Pure.

Strength of solution: 38 degrees, 40 degrees, 42 degrees, 43 degrees Re.

Containers: Carboys; glass bottles.

Fire hazard: Dangerous.

Railroad shipping regulations: White label.

ALBUMEN, EGG: Fresh white separated from the yolk, diluted with water, beaten to a froth and subsequently filtered and evaporated. Alkaline reaction.

COLLODION (Pyroxyline; Flexible collodion).

Derivation: Solution of nitrated cellulose in ether and alcohol.

Color and properties: Pale yellow, sirupy liquid; very inflammable.

Fire hazard: Dangerous.

Railroad shipping regulations: Red label.

NITROCELLULOSE (Gun-cotton).

Color and properties: Yellowish, amorphous lumps; inflammable, explosive.

Soluble in a mixture of alcohol and ether.

Insoluble in alcohol, water and ether.

Derivation: Hanks of cotton, free from impurities, are nitrated in mixed acid, removed from the acid, whizzed in a centrifuge to remove as much acid as possible, washed in water until no acid reaction remains, and finally boiled in several changes of water.

Containers: Wooden boxes.

Fire hazard: Dangerous.

Railroad shipping regulations: Prohibited by express.

ETHYL ALCOHOL (Grain alcohol; Fermentation alcohol; Cologne spirit; Spirits of wine.) C_2H_5OH.

Color and properties: Colorless, limped, volatile liquid; ethereal; pungent taste.

Denatured alcohol is an alcohol rendered unfit for human consumption by the addition of menthyl alcohol.

ETHER (Sulphuric ether; Ethyl ether; Ethyl oxide).

Color and properties: Very light, transparent, colorless, volatile, exceedingly inflammable, mobile liquid, pleasant aromatic odor.

Derivation: By the action of sulphuric acid on ethyl alcohol, followed by distillation.

AMMONIUM IODIDE NH_4I.—White Crystals. Soluble in water and alcohol.

CADMIUM IODIDE CdI_4.—Colorless, flakey crystals.

Soluble in water, alcohol and ether.

CALCIUM CHLORIDE $CaCl_2$.—White, deliquescent crystals, granules or lumps.

STRONTIUM CHLORIDE $SrCl_2$.—White, crystalline needles; sharp, bitter taste. Soluble in water and alcohol.

SILVER NITRATE (Lunar caustic) $AgNO_3$

Color and properties: Colorless, crystal plates, darkening on exposure to light in presence of organic matter, caustic metallic taste; poisonous and corrosive.

Derivation: Silver is dissolved in dilute nitric acid, the solution evaporated.

Imprints: Copper nitrate.

Containers: Amber or black glass bottles.

Fire hazard: Dangerous.

Railroad shipping regulations: Yellow label.

IRON SULPHATE (Ferrous sulphate; Copperas; Green Vitrol) $FeSO_4$; $7H_2O$.

Color and properties: Greenish crystals, often musty in color from oxidation and efflorescence.

Soluble in water, insoluble in alcohol.

Derivation: A by-product from the manufacture of steel, and by the action of dilute sulphuric acid on iron and with subsequent crystallization.

ACETIC ACID $HC_2H_3O_2$.—Vinegar is a dilute, impure acetic acid.

Strength of solution: 90 per cent, 80 per cent, 60 per cent, 36 per cent, 30 per cent, 28 per cent.

Railroad shipping regulations: White label.

POTASSIUM CYANIDE K. C. N.

Color and properties: White amorphous, deliquescent lumps or crystalline mass; faint odor of bitter almonds; extremely poisonous, do not handle with bare hands!

COPPER SULPHATE (Cupric sulphate; Blue vitriol; Blue stone) $CuSO_4$ $5H_2O$.

Color and properties: Blue crystals, slowly efflorescing in air; poisonous.

Derivation: By the action of dilute sulphuric acid on copper or copper oxid in large quantities, with evaporation and crystallization.

POTASSIUM BROMIDE K. Br.

Color and properties: White, crystalline, granules or powder; pungent, strong, bitter saline taste.

IODINE I_2

Color and properties: Purplish-black, flat, volatile crystals; poisonous, corrosive.

Soluble in alcohol, chloroform, ether, glycerine and alkaline iodide solutions; insoluble in water.

Derivation: From the ashes of sea weeds or mother liquors of Chili saltpetre by the addition of sodium bi-sulphite solution. The precipitated iodine is collected and dried.

POTASSIUM IODIDE K.i.

Color and properties: White crystals, granules or powder; strong, bitter saline taste.

Soluble in water, alcohol and ether.

Grades: Crystals, granulated; powder; V. S. P.; B. P.

SODIUM SULPHIDE (Sodium surphuret; Sodium monosulphide) N.a$_2$S.

Color and properties: Yellowish or brick-red lumps; soluble in water.

AMMONIUM CHLORIDE (Sal ammonium) $N.H_4Cl$.

Color and properties: White crystals; commercial actical grayish.

CADMIUM BROMIDE $C.dBr_2$

Color and properties: Yellowish, crystalline powder.

AMMONIUM HYDROXIDE (Aqua ammonia; Ammonium hydrate) $N.H_4O.H.$; Colorless liquid.

MERCURIC CHLORIDE (Corrosive sub-

limate; Mercury bi-chloride; Mercury chloride, corrosive.) $HgCl_2$

Color and properties: White crystals; very poisonous!

Grades: Technical; lump; crystals; granular, powder; V. S. P.. B. P.

LOAD NITRATE $Pb(NO_2)_3$

Color and properties; White crystals.

Derivation: By the action of Nitric acid on lead.

Fire hazard: Dangerous.

Railroad shipping regulations: Yellow label.

POTASSIUM FERRICYANIDE (Red prussiate of potash; Potassium prussiate, Red) $K_3Fe(CN)_6$

Color and properties: Bright red, lustrous crystals or powder; poisonous.

SODIUM CYANIDE NaCN.

Color and properties: White, deliquescent, crystalline powder; exceedingly poisonous.

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